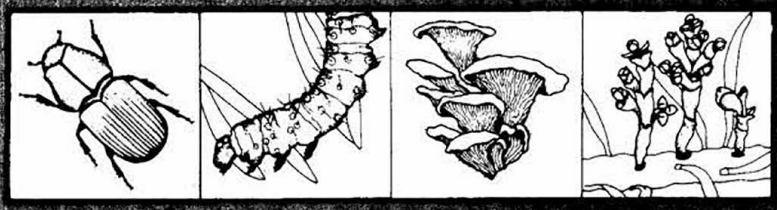
Forest Pest Management



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ROOT DISEASE OF CONTAINERIZED CONIFER SEEDLINGS WESTERN FOREST SYSTEMS NURSERY, LEWISTON, IDAHO

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ABSTRACT

Investigations of containerized western white pine, western larch, and Douglas-fir seedlings at the Western Forest Systems Nursery in Lewiston, Idaho, revealed that many seedlings were colonized with *Fusarium oxysporum* although they lacked severe disease symptoms. White pine seedlings were also infected with *Pythium* spp., probably as a result of sowing infected seed. Styroblock containers in which seedlings were being grown were often colonized with *F. oxysporum*. Infected containers may be an important source of *Fusarium* inoculum and may provide the means by which these fungi are transmitted from one crop of seedlings to the next.

INTRODUCTION

At the Western Forest Systems Nursery in Lewiston, Idaho, root diseases of containerized conifer seedlings occur periodically in most crops, but losses have usually been kept low by application of fungicides. Recent production of western white pine (*Pinus monticola* Dougl.) has been hampered by reduced seed germination and higher than normal levels of root disease. The problem was primarily due to seed contaminated with pathogenic fungi (James 1987b). Also, young Douglas-fir (*Pseudotsuga menziesii* (Mirb.) Franco) seedlings were recently discovered which lacked fine feeder roots. Samples of diseased Douglas-fir seedlings were analyzed by Penisu-lab (Kingston, WA) and found to be colonized with *Pythium* spp.

Growers were concerned about potential for root disease losses at their nursery and especially the possible role of contaminated styroblock containers in providing root pathogen inoculum for successive seedling crops. Therefore, samples of western white pine, western larch (*Larix occidentalis* Nutt.) and Douglas-fir containerized seedlings were submitted by growers for evaluation.

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MATERIALS AND METHODS

Analyzed seedlings were without severe root disease symptoms. A total of 27 seedlings and the containers they were being grown in were analyzed for presence of *Fusarium* spp. and *Pythium* spp., two of the most common groups of root pathogens. Each seedling was carefully examined for presence of foliar symptoms that might indicate root disease. Seedlings with foliar symptoms were given a numerical root disease rating based on a severity system described in Table 1. Each seedling was measured (height from the groundline and caliper just above the groundline) and oven-dry weight of all above-ground portions was determined. Seedlings were then carefully extracted from containers to obtain as much of their root systems as possible. Roots were washed thoroughly under running tap water to remove adhering soil particles. They were then surface sterilized in 10 percent aqueous sodium hypochlorite and rinsed with sterile distilled water. Ten lateral roots were randomly selected and the bottom 10 mm aseptically severed. These severed tips were then bisected and one piece placed on a selective medium for *Fusarium* (Komada 1975) and the other on a selective medium for *Pythium* (V-8 juice agar amended with selected antibiotics). *Fusarium* plates were incubated at about 25 degrees C for 7 days under diurnal cycles of cool fluorescent light and *Pythium* plates were incubated for 3 days at about 24 degrees C in the dark. Fungi emerging from roots were transferred to potato dextrose agar or carnation leaf agar and identified using standard taxonomic guides (Middleton 1943; Nelson et al. 1983).

Table 1.--Numerical root disease rating system based on above-ground foliar symptoms.

Rating	*Description*
0.	*No symptoms, seedling crown entirely green.*
1.	*Seedling with slight needletip dieback, particularly concentrated on the upper whorl of needles.*
2.	*Seedling with lower whorl of needles partially or completely necrotic; seedling upright.*
3.	*Seedling with needletip dieback affecting at least one-half of the crown.*
4.	*Seedling with one-half of its crown with necrotic foliage (upper or lower); seedling upright.*
5.	*Seedling with one-half of its crown with necrotic foliage(upper or lower); seedling bent over.*
6.	*Seedling with three-fourths of its crown with necrotic foliage; seedling may be upright or bent over.*
7.	*Seedling with its entire crown necrotic; seedling may be upright or bent over.*

Styroblock cells from which each seedling came were also sampled for both *Fusarium* and *Pythium*. The bottom portions of each cell were aseptically severed with a scalpel and divided into eight pieces of approximately equal size. Four of the pieces were placed on the selective medium for *Fusarium* and four on the *Pythium* medium. Plates were incubated as described above. Percentages of root and styroblock container pieces colonized by *Fusarium* and *Pythium* were determined.

RESULTS AND DISCUSSION

More than 70 percent of the white pine seedlings sampled were infected with *Fusarium* (Table 2). White pine seedlings from both new (first crop) and old (used previously for at least one crop) containers were about equally infected with *Fusarium* (Table 2). Most styroblock cells with white pine seedlings also were colonized with *Fusarium* spp., although old containers were colonized to a greater extent than new ones. On the other hand, larch seedlings grown in new containers were much more colonized with *Fusarium* than those in old containers. The Douglas-fir seedlings sampled were extensively colonized with *Fusarium* as well as the container cells in which they were being grown. This high level of infection was common despite a general lack of root disease symptoms of sampled seedlings. Previous observations (James et al. 1987; James and Gilligan 1988a) have confirmed that *Fusarium* spp. commonly colonize roots of container seedlings without eliciting disease symptoms. Apparently, environmental conditions that are conducive to disease or affect host vigor must be required for disease to result from root infection.

More seedlings were colonized with *Fusarium* than with *Pythium*. *Pythium* was isolated frequently only from the white pine seedlings. This may have been the result of seed infection with *Pythium* (James 1987b). The only species of *Fusarium* consistently isolated from infected seedlings and styroblock containers was *F. oxysporum* Schlect. This common species is often associated with diseases of containerized conifer seedlings (James 1987a, James 1987c), but is also a common colonizer of the roots of seedlings without disease symptoms (James and Gilligan 1988a).

It appears that the styroblock containers used at the Western Forest Systems Nursery can and probably do commonly harbor inoculum of both *Fusarium* and *Pythium*. This may be an important way these fungi are introduced into successive crops of seedlings, unless cleaning procedures are effective in reducing or eliminating inoculum. Previous investigations with styroblock (James et al., 1988) and Leach® (James and Gilligan 1988b) containers indicate that commonly used cleaning procedures generally fail to eliminate or greatly reduce levels of *Fusarium* within containers. It is likely that the organisms residing on or within containers are capable of causing damping-off and root diseases, although pathogenicity tests to confirm this hypothesis have not yet been conducted.

It is recommended that growers evaluate efficacy of existing cleaning procedures in reducing inoculum within containers. If relatively high levels persist despite cleaning, alternative methods of cleaning should be evaluated.

Table 2.--Colonization of conifer seedling roots and styroblock containers with *Fusarium* spp. and *Pythium* spp. Western Forest Systems Nursery, Lewiston, Idaho.

Species	Container age[1]	Number seedlings sample	Avg. root disease rating[2]	Avg. height (cm)	S.D.	Average caliper (mm)	S.D.	Average oven-dry weight (gms)	S.D.	*Fusarium* Colonization: Percent seedling	*Fusarium* Colonization: Root colonization intensity[3]	*Fusarium* Colonization: Percent container	*Fusarium* Colonization: Container colonization intensity[3]	*Pythium* Colonization: Percent seedling	*Pythium* Colonization: Root colonization intensity[3]	*Pythium* Colonization: Percent container	*Pythium* Colonization: Container colonization intensity[3]
White pine	New	4	0	11.4	0.98	4.0	0	2.05	0.69	75.0	32.5	50.0	31.2	25.0	2.5	50.0	18.8
White pine	Old	7	0.1	8.7	1.74	3.3	0.49	1.37	0.70	71.4	25.7	100.0	60.7	14.3	1.4	0	0
Western larch	New	4	NA	21.8	1.21	3.0	0	0.94	0.20	100.0	85.0	100.0	93.8	0	0	0	0
Western larch	Old	6	NA	9.2	2.49	1.8	0.41	0.40	0.21	16.7	3.3	16.7	8.3	0	0	16.7	4.2
Douglas-fir	New	6	0.5	11.3	2.80	2.8	0.41	0.54	0.11	100.9	98.3	100.0	100.0	0	0	0	0

[1] New - first time used; Old = been used for at least one previous crop.

[2] See Table 1 for descriptions.

[3] Percentage of sampled root and container pieces colonized with *Fusarium* and *Pythium* spp.

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